CIAIAC

COMISIÓN DE
INVESTIGACIÓN
DE ACCIDENTES
E INCIDENTES DE
AVIACIÓN CIVIL

Report IN-008/2018

Incident involving a Boeing 737-700, registration D-AGEU, operated by Germania, in the Canaries airspace (Spain) on 3 March 2018

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

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SUBSECRETARÍA
COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

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Foreword

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

CONTENTS

Abbreviations

º/s	Degree/second
AMM	Aircraft maintenance manual
APP	Approach control
ATPL	Airline transport pilot license
ATS	Air Traffic Service
CPC	Cabin pressure controller
EBOX	Electronic box
EDDB	Berlin Schonefeld Airport
FIR	Flight information region
FL	Flight level
FLT ALT	Flight altitude
ft	Feet
Ft/min	Feet/minute
GCFV	Fuerteventura Airport
h	Hours
IAW	Initial airworthiness
ICAO	International Civil Aviation Organization
IFR	Instrument flight rules
IR	Instrument rules
km	Kilometer
kt	Knots
LAND ALT	Altitude at destination airport
LDA	Landing distance available
LECS	Seville FIC/ACC

LEMG	Málaga-Costa del Sol Airport
LV	Low Visibility
m	Meters
MEL	Minimum equipment list
MOC	Maintenance operations center
N/A	Not affected
NNC	Non-normal checklist
NVM	Non-volatile memory
OFV	Outflow valve
PA	Public address system
PIC	Pilot in command
PF	Pilot Flying
PM	Pilot Monitoring
QRH	Quick reference handbook
s	Seconds
SCCM	Senior cabin crew member
UTC	Coordinated universal time

Synopsis

Owner:	WWTAI AirOpCo II DAC
Operator:	Germania
Aircraft:	Boeing 737-700
Persons on board:	5 crew and 123 passengers, 3 minor injured
Type of flight:	Commercial air transport – Scheduled – International – Passenger
Phase of flight:	En route
Type of operation:	IFR
Date and time of incident:	3 March 2018 at 18:28 [1]
Site of incident:	Canaries airspace
Date of approval:	30 January 2019

Summary of event:

On Saturday, 3 March 2018, a Boeing 737-700, registration D-AGEU, operated by Germania, took off from the Fuerteventura Airport, in Spain, en route to the Berlin Schönefeld Airport, in Germany.

During the cruise phase, while at FL380, the cabin crew felt intense and sudden changes in pressure. After looking at the cabin rate of climb indicator, they realized there was a problem with the cabin pressurization. Seconds later, the visual and aural cabin altitude warning was activated, after which the crew donned their oxygen masks.

The pilot monitoring noticed that the flight altitude (FLT ALT) and landing altitude (LAND ALT) readings were displaying dashes, which led the crew to conclude that there must have been a dual failure of the cabin pressure controller (CPC).

In the meantime, the cabin altitude had uncontrollably reached 15,000 ft. The passenger oxygen masks deployed automatically once the cabin altitude rose above 14,000 ft.

[1] All times in this report are in local time in the Canary Islands, which is the same as UTC.

The crew declared a MAYDAY to air traffic control and reported their intention to make an emergency descent.

During the descent, the crew manually regained control of the cabin pressure, after which they decided to cancel the emergency declaration.

The crew decided to divert and land at the Málaga Airport, which they did without further incident.

Three passengers were minor injured as a result of the event.

The investigation was unable to reliably determine the cause of this incident:

1. According to the studies conducted during the investigation into this incident, it may have been caused by two possible faults.

   Initially, the #2 cabin pressure controller (CPC2) commanded the outflow valve (OFV) to open completely. The upset that opened the OFV was caused by corrupted data in the CPC. The source of that corrupted data was either a SEU or the result of failing solder joints.

   Later, due to the stiffness of the OFV, the #1 cabin pressure controller (CPC1) was unable to return it to its closed position and thus stabilize the cabin pressure. This may have been a factor contributing to the severity of the depressurization. It was possible to identify what caused the stiffness of the OFV.

2. After the incident, suspecting that both cabin pressure controllers had failed simultaneously, they were replaced; however, various anomalies continued to occur involving the loss of cabin pressure.

3. The aircraft operator did not provide information on what caused the loss of cabin pressure after the cabin pressure controllers were replaced. Moreover, it is not known if these subsequent incidents were analyzed in detail by the operator.

On 3 March 2018, before the incident, two other incidents involving cabin pressure were reported. It is thought that the lack of a detailed analysis of these prior incidents by the operator's maintenance technicians could have been a contributing factor in this incident.

1. FACTUAL INFORMATION

1.1. History of the flight

On Saturday, 3 March 2018, a Boeing 737-700, registration D-AGEU, operated by Germania, took off from the Fuerteventura Airport, in Spain, en route to the Berlin Schönefeld Airport, in Germany.

During the cruise phase, while at FL380, the cabin crew felt intense and sudden changes in pressure. After looking at the cabin rate of climb indicator, they realized there was a problem with the cabin pressurization. Seconds later, the visual and aural cabin altitude warning was activated, after which the crew donned their oxygen masks.

The pilot monitoring noticed that the flight altitude (FLT ALT) and landing altitude (LAND ALT) readings were displaying dashes, which led the crew to conclude that there must have been a dual failure of the cabin pressure controller (CPC).

In the meantime, the cabin altitude had uncontrollably reached 15,000 ft. The passenger oxygen masks deployed automatically once the cabin altitude rose above 14,000 ft.

The crew declared an emergency situation (MAYDAY) to the air traffic control service in Casablanca, Morocco, reporting their intention to make an emergency descent. The ATS did not authorize the emergency descent and instead instructed the crew to contact Spanish ATS.

After contacting Spanish ATS, the crew reported they were making an emergency descent.

During the descent, the crew manually regained control of the cabin pressure, after which they decided to cancel the emergency declaration.

The crew decided to divert and land at the Málaga Airport, which they did without further incident.

Three passengers were minor jured as a result of the event.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Fatal				
Serious				
Minor		3	3	N/A
None	5	120	125	N/A
TOTAL	**5**	**123**	**128**	

1.3. Damage to aircraft

The aircraft was not damaged.

1.4. Other damage

There was no other damage of any kind.

1.5. Personnel information

The pilot, a 34-year-old German national, had an airline transport pilot license (ATPL(A)) first issued on 10 March 2014 by the German Civil Aviation Authority, and PIC and IR ratings for the B737 300-900, that were valid until 28 February 2019.

He had a class-1 medical certificate that was valid until 16 February 2019.

The first officer, a 41-year-old British national, had an airline transport pilot license (ATPL(A)) first issued on 12 April 2017 by the Civil Aviation Authority of the United Kingdom, and a B737 300-900/IR/LV rating that was valid until 28 February 2019.

The first officer had a class-1 medical certificate that was valid until 20 February 2019.

1.6. Aircraft information

The Boeing 737-700 aircraft, registration D-AGEU and serial number 28014, was entered into the aircraft registry of the German Civil Aviation Authority on 22 Dcember 2017.

It had a certificate of airworthiness issued by the German Civil Aviation Authority.

Description of the cabin pressurization control system

The cabin pressurization control system controls the rate at which air is released from the cabin through the position of the outflow valve.

The pilots can control the cabin pressurization using the following modes:

- Automatic
- Manual

In the automatic mode, the controllers automatically program the cabin pressure for every phase of flight. The system has two redundant automatic, digital control channels consisting of a cabin pressure controller, an outflow valve auto motor and electronic box and the automatic functions within the flight deck pressurization control panel. If both control channels fail, the pilot can control the outflow valve manually.

If none of the control modes are effective, there are mechanisms to protect the airframe from an excessive differential pressure:

- Two safety relief valves
- One negative pressure relief valve

In normal operations, the cabin pressure altitude never exceeds 8,000 ft. When the cabin pressure altitude exceeds 10,000 ft, a cabin altitude warning system would alert the crew.

Maintenance activities

A list of the maintenance activities of most relevance to this incident is provided below, in chronological order:

1. On 3 February 2018, the following entry was made in the aircraft's maintenance log: #2 cabin pressure controller inoperative. Deactivated as per the MEL. After this, on 9 February, the cabin pressure controller (CPC2) was replaced.

The operator was asked if any incidents involving the #2 cabin pressure controller were reported between 9 February 2018 and the day of the incident, 3 March 2018. They did not answer to this specific question.

2. On 3 March 2018, before the incident reported herein, two other maintenance events were reported, one at 03:30 UTC, and the other at 05:02 UTC, both involving a "failure of one of the cabin pressurization control systems". In both cases, the "Cabin pressure controller ground test IAW AMM 21-31-TASK 801 Rev 64" was conducted satisfactorily. During the investigation, the operator was asked which of the two cabin pressure controllers had given these problems. The operator replied that both failed simultaneously.

3. On a subsequent flight made that same day, the incident investigated herein occurred.

4. On 4 March 2018, suspecting that both cabin pressure controllers could have failed simultaneously, both were replaced, as per task 21-31-01-400-801, and a loss of cabin pressure test was conducted, as per AMM 05-51-91-790-801 Rev. 64, after which the airplane was returned to service.

- However, after both cabin pressure controllers were replaced, various problems continued to occur. On 6 March 2018, an entry was made in the aircraft's maintenance log involving "loss of cabin pressure. Replace cabin pressure control module", after which the cabin pressure module selector was replaced.

  The operator was asked what caused this new anomaly after the replacement, on 4 March, of the two cabin pressure controllers. The operator did not provide any information in this regard.

- Subsequently, on 10 March 2018, both safety relief valves were replaced, as was the outflow valve. This change was prompted by a constant change in the cabin altitude climb/descent rate of between +400/500 ft/min and -400/500 ft/min during the cruise phase.

  The operator was also asked about the cause of this other anomaly, and if it occurred later. The operator did not provide any information in this regard.

1.7. Meteorological information

Aside from a drizzle, with the presence of some low stratus clouds, there do not seem to have been any significant events in the area of the incident.

1.8. Aids to navigation

The most significant moments of the radar track for the aircraft involved in the incident are shown below.

At 18:29:18, when the cabin depressurized, the aircraft was at FL380, flying over point OSDAM.

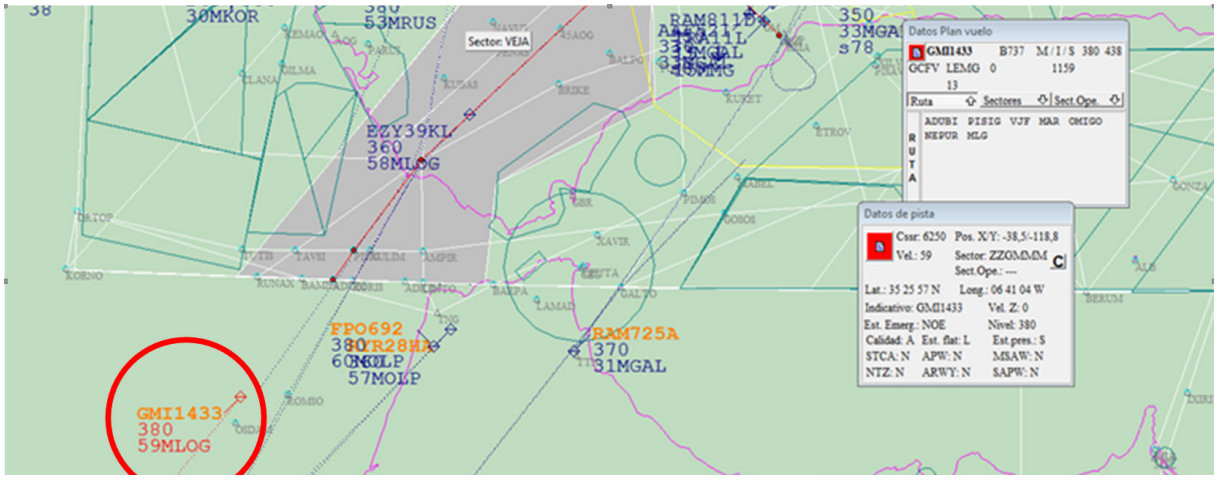

Illustration 1: Aircraft's position at 18:29:18

After that point, the aircraft began to descend. By 18:35:49, when the crew declared the emergency over, the aircraft had descended to FL208:

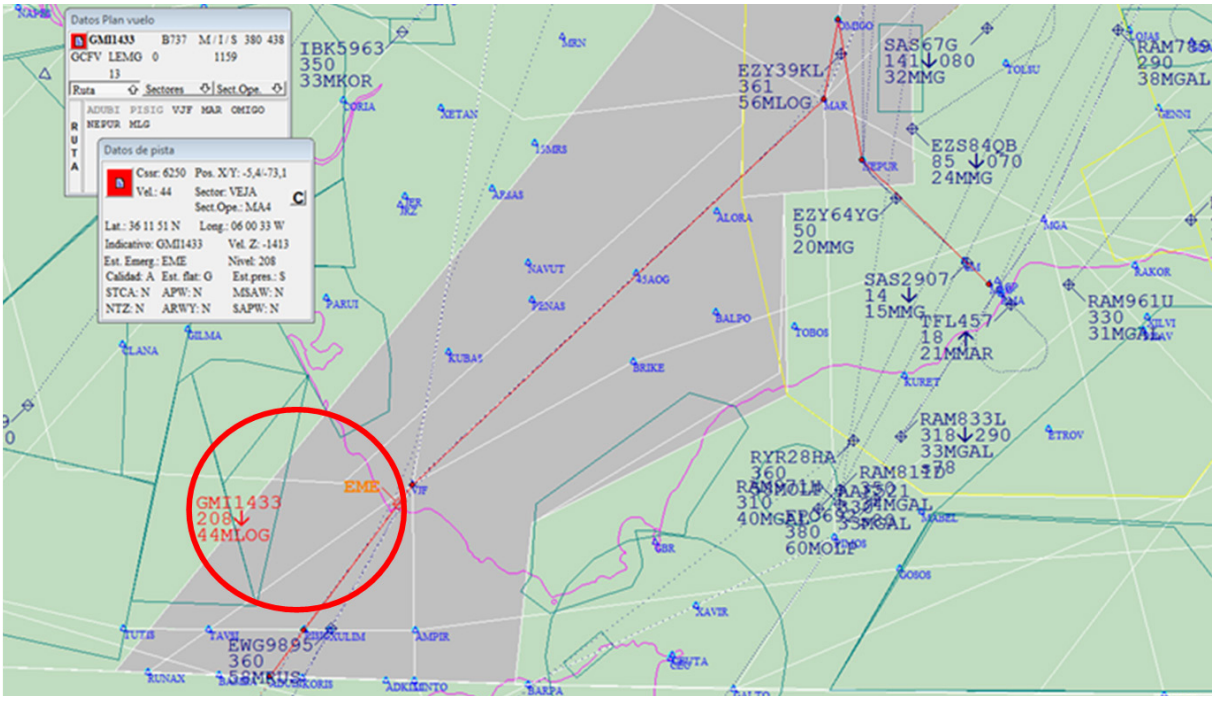

Illustration 2: Aircraft's position at 18:35:49

After resolving the emergency situation, at 18:38:24, the crew decided to divert to the Málaga Airport. The aircraft's position at that instant is shown below:

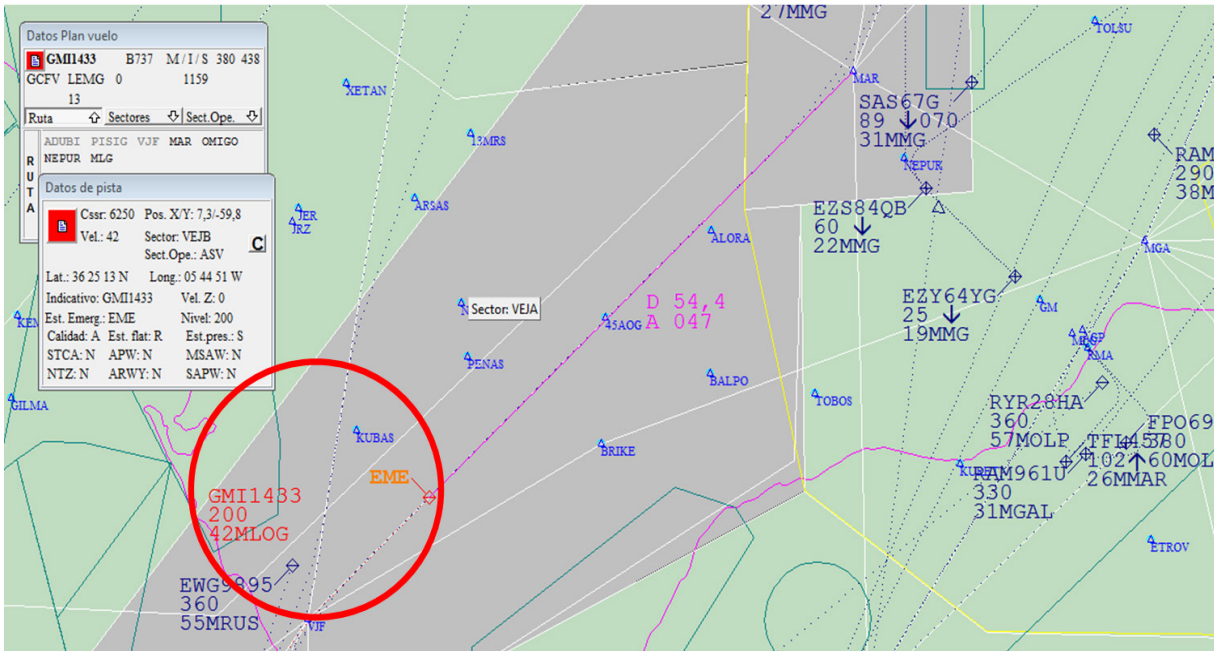

Illustration 3: Aircraft's position at 18:38:25

1.9. Communications

The communications between the pilot and the air controller of most significance to an analysis of the incident are provided below.

At 18:29:18, the aircraft contacted the sector MA4 controller in LECS to report that it needed to make an emergency descent and declared a "MAYDAY". The controller cleared it to descend to FL200.

At 18:35:42, the aircraft canceled the MAYDAY, since the pilot was able to control the situation.

At 18:38:24, the pilot decided to divert to the Málaga Airport.

At 18:43:25, the pilot informed the LEMG APP controller that a passenger had been injured by the decompression and that they would need medical assistance. The aircraft itself was technically sound.

After this, it landed without reporting further incidents.

1.10. Aerodrome information

The aircraft had taken off from the Fuerteventura Airport (GCFV) en route to the Berlin Schönefeld Airport (EDDB). As a result of the incident, the crew decided to divert to the Málaga Airport (LEMG).

The Málaga-Costa del Sol Airport, located 8 km southwest of the city of Málaga, has two runways in a 12/30 and 13/31 orientation, whose landing distance available (LDA) is 2750 m and 3200 m, respectively. It is at an elevation of 16 m/52 ft.

1.11. Flight recorders

The data needed to analyze this incident were not taken from the aircraft's flight recorder; rather, they were obtained from the non-volatile memory (NVM) of the cabin pressure controllers (CPC).

Therefore, investigators did not consider it necessary to analyze the aircraft's flight recorder.

1.12. Wreckage and impact information

The incident aircraft did not sustain any damage.

1.13. Medical and pathological information

There are no indications that physiological factors or an incapacity affected the performance of the flight crew.

1.14. Fire

There was no fire in the aircraft or its surroundings.

1.15. Survival aspects

Not applicable.

1.16. Survival aspects

Statement from the crew of the aircraft

They were flying from the Fuerteventura Airport to the Berlin-Schönefeld Airport at FL380, in the Casablanca FIR, near the Seville FIR. The captain was the pilot flying and the first officer was the pilot monitoring. The seatbelt sign was on, since they expected turbulence during the flight.

At one point, the cabin crew felt intense pressure changes (ears popping). The cabin rate of climb indicator showed a change of over 1,500 feet/minute, which indicated a problem with the pressurization. The visual and aural cabin altitude alert was instantly activated.

In keeping with QRH procedure NNC 2.1, Cabin Altitude or Rapid Depressurization Alert, they donned their oxygen masks and established communication between the crew. The first officer noticed that the FLT ALT and LAND ALT readings were displaying dashes, which led them to infer that it was a dual controller failure.

In the meantime, the cabin altitude reached 15,000 feet uncontrollably. The passenger oxygen alert was already activated, meaning the passenger oxygen masks had dropped automatically at a cabin altitude of 14,000 feet.

They decided to descend as per procedure NNC 0.1, Emergency Descent. The captain called out "Descent" three times over the PA, and the first officer informed the Seville air control center of their emergency situation, declaring a MAYDAY and the need to descend.

During the descent, they were able to pressurize the cabin manually, which resulted in intense pressure changes of up to 3,000-4,000 feet in cabin altitude, to a value of around 8,000 feet. They decided to cancel the MAYDAY.

They established communications with the purser and requested a status report from her. The cabin crew reported that three passengers were injured, but that, in general, the passengers were calm.

They decided to divert to the Málaga Airport, landing with an excess weight of 300 kg. After reaching the parking stand, the medical service tended to the injured passengers. Two passengers required supplemental oxygen despite suffering no injuries. A third passenger was bleeding from the ear due to, according to doctors, a blood thinning drug.

Later, technicians from a maintenance company assigned by the MOC reported to the airplane, where they troubleshot the cabin pressure controllers and determined the presence of faults in both controllers.

Analysis of the components

The following components were studied in detail during the investigation into this incident:

1. Master Cabin Pressure Controller #1 (CPC1), serial number 9860315, installed on the aircraft until 4 March 2018.

2. Slave Cabin Pressure Controller #2 (CPC2), serial number 0311951, installed on the aircraft between 3 February 2018 and 4 March 2018. This controller had previously been uninstalled from another aircraft due to a fault ("Auto Fail Light After Landing") and repaired in the shop.

3. Outflow valve (OFV), serial number 9710529, installed on the aircraft until 10 March 2018.

4. Safety relief valve, serial number 9705043, installed on the aircraft between 11 February 2015 and 10 March 2018.

5. Safety relief valve, serial number 9706016, installed on the aircraft between 11 February 2015 and 10 March 2018.

1.- Analysis of the outflow valve (OFV)

The aircraft operator sent the outflow valve to Lufthansa Technik AG for analysis. The following deficiencies were found:

- Valve assembly: connecting cable damaged, pins and nuts corroded.
- Gear box: several worn bearings.
- Electronic box 2: several weld joints cracked in the power supply board and in the circuit board.

2.- Analysis of the safety relief valves

The aircraft operator sent the safety relief valves to Hamilton Sundstrand Aviation Services for analysis. The following deficiencies were found:

On the safety relief valve with serial number 9705043, the deflecting washer was loose.

On the safety relief valve with serial number 9706016, the differential response pressure test failed.

3.- Analysis of the non-volatile memory on CPC1 and CPC2

The aircraft operator asked the manufacturer of the pressure system components, Nord-Micro, to study them. After examining the non-volatile memory on both cabin pressure controllers, Nord-Micro concluded that two consecutive and independent faults occurred one of which caused the incident the other which contributed to the severity of the depressurization:

- First, CPC2 opened the OFV at an angular speed of 12º/s.

  The opening of the OFV was caused by a single alteration of data in a memory cell in CPC2, or by faulty data caused by fatigue in one of the solder joints. Piece parts on the main board had been soldered in CPC2. The corruption of the data caused an erroneous calculation of the target outflow valve position which led to an incorrect command to open the outflow valve.

This movement of the valve was contained by the "high cabin rate" failure function on this CPC, though by that point, the OFV had already been opened to 90º.

- CPC1 then assumed control and the pressure switch in the corresponding OFV EBOX activated to drive the OFV toward closed at maximum rate.

  Due to the stiffness of the OFV, it was unable to drive the OFV to the closed position at the necessary angular speed, so the cabin altitude rose even more.

  A check of the gear box in the OFV revealed worn bearings, which caused the OFV to move stiffly and made it unable to be controlled by CPC1.

- The pilots initiated an emergency descent and were able to restore the cabin altitude in manual mode according to pilot reports.

Suitability of the "Cabin pressure controller ground" test

On 3 March 2018, before the incident considered herein, two other incidents were reported to maintenance. In both, the "Cabin pressure controller ground test IAW AMM 21-31-TASK 801 Rev 64" was performed, with satisfactory results.

During the investigation, the aircraft manufacturer was asked about the suitability of this test to identify the malfunction of the cabin pressure controller or the rigidity of the outflow valve.

The manufacturer stated that when the cabin pressure control system displays an AUTO FAIL, the Fault Isolation Manual can be used to identify what caused the AUTO FAIL and the possible steps to resolve it.

Tests on the ground can identify the faults that exist when the test is carried out. However, "high cabin rate" (due to the uncontrolled opening of the outflow valve by the #2 cabin pressure controller) and "loop closure fail" (due to the #1 cabin pressure controller's inability to close the outflow valve to its stiffness) faults cannot be identified during tests on the ground because these conditions can only be present in flight.

However, the stiffness of the outflow valve can be detected by means of a specific ground test if the stiffness is high enough that the rotational speed check portion of the test fails.

1.17. Organizational and management information

Not applicable.

1.18. Additional information

Operator's actions

The operator carried out an internal analysis of the event, after which it implemented a series of actions to avoid a reoccurrence of a similar incident. The actions taken are listed in the table below:

Observations/Findings	Safety actions
During the incident, the pilot did not check the position of the outflow valve	1.- Communication to all company pilots through the Flight Safety Bulletin; 2.- Action for the company's Training Department for the next simulator session, which will include a similar event to train on the importance of monitoring the position of the outflow valve.
The aircraft was returned to service without having solved the problem.	1.- Check if the procedure for returning an aircraft to service after such a serious event is acceptable; 2.- Check if the organizational structure is acceptable for identifying faults after events.
Multiple CPC faults	The CPC and OFV involved in the incident will not be reinstalled on any of the operator's aircraft.

1.19. Useful or effective investigation techniques

No special investigation techniques were employed.

2. ANALYSIS

2.1. Chronological analysis of the event

On 9 February 2018, the #2 cabin pressure controller (CPC2) was replaced with another one that had been repaired in the shop. The reason for the repair is that the unit had failed in another aircraft.

It is not known if any incident involving CPC2 was reported between 9 February 2018 and the day of the incident, 3 March 2018, since the operator did not provide information in this regard.

On 3 March 2018, before the incident investigated herein, there were two events in which the cabin pressure control systems were reported to have malfunctioned. In both events, the operator's maintenance technicians performed the *"Cabin pressure controller ground test IAW AMM 21-31-TASK 801 Rev 64"*. When the result of this test was satisfactory, they returned the aircraft to service.

After the incident investigated herein, Nord-Micro did a detailed study of the non-volatile memory in the cabin pressure controllers and Lufthansa Technik studied the outflow valve. Nord-Micro concluded that the incident was triggered by two consecutive and independent faults. Initially, the #2 cabin pressure controller (CPC2) commanded the outflow valve (OFV) to open fully, and later, because of the stiffness of this valve, the #1 cabin pressure controller (CPC1) was unable to return it to the closed position and thus stabilize the cabin pressure.

Nord-Micro was unable to determine what caused CPC2 to malfunction and fully open the outflow valve. After analyzing the non-volatile memory of the cabin pressure controllers, it concluded that the OFV was opened by a single alteration in a memory cell in CPC2, or by faulty data caused by fatigue in one of the weld joints in CPC2. In the first case, meaning a single alteration, this would have been caused by environmental conditions; specifically, atmospheric radiation. In the second case, meaning if the cause was fatigue in the weld joints of CPC2, the problem would be limited to this specific unit.

Lufthansa Technik was able to identify what caused the stiffness of the outflow valve.

Furthermore, as the aircraft manufacturer stated, the *"Cabin pressure controller ground test IAW AMM 21-31-TASK 801 Rev 64",* performed on two occasions before this incident, would not have identified either the malfunction of the cabin pressure controllers or the stiffness of the outflow valve. It is not known why the maintenance technicians conducted only this test to identify the fault in the cabin pressurization.

As the operator is no longer operating, a safety recommendation will not be issued to the maintenance technicians to have them correctly use the information provided by the cabin pressure control system and the Fault Isolation Manual so as to properly identify and solve the problem.

Following this incident, the cabin pressure controllers were replaced and a loss of cabin pressure test was done as per the *AMM 05-51-91-790-801 rev 64*, after which the airplane was returned to service. However, various anomalies continued to occur:

- On 6 March 2018, an entry was made in the aircraft's maintenance log involving *"loss of cabin pressure. Replace cabin pressure control module"*, after which the cabin pressure module selector was replaced.

- Subsequently, on 10 March 2018, both safety relief valves were replaced, as was the outflow valve. This change was prompted by a constant change in the cabin altitude climb/descent rate of between +400/500 ft/min and -400/500 ft/min during the cruise phase.

That is, despite the replacement, on 4 March, of the two cabin pressure controllers, problems were reported on 6 and 10 March. The operator did not provide information on what caused these new incidents. Moreover, it also did not indicate if more incidents involving loss of cabin pressure were reported after 10 March.

2.2. Analysis of the actions of ATS

When the incident began, the aircraft was in the CASABLANCA FIR. The crew, therefore, declared the emergency (MAYDAY) to the CASABLANCA air traffic control service in Morocco, reporting their intention to make an emergency descent. But the control service did not authorize the emergency descent, instead instructing the crew to contact Spanish air traffic control.

ICAO Annex 11, Air traffic services, to the Convention on International Civil Aviation, includes a requirement on the services to provide to aircraft in the event of an emergency, which states:

"2.24.1 An aircraft known or believed to be in a state of emergency, including being subjected to unlawful interference, shall be given maximum consideration, assistance and priority over other aircraft as may be necessitated by the circumstances."

No safety recommendation is issued to Moroccan air traffic control services since the ICAO already considers in its regulation, applicable to signatory States of the Convention on Civil Aviation, the requirement to provide consideration, assistance and priority over other aircraft to an aircraft that has declared an emergency.

2.3. Analysis of the pilot's actions

Analyzing the data in the non-volatile memory of the cabin pressure controllers revealed that the position requested for the OFV during the incident was different from the indicated position of the OFV.

Following its internal investigation, the operator is going to take a series of actions to make pilots aware of the need to monitor the position of the outflow valve. These include issuing a flight safety bulletin and including a similar event during a simulator training session.

This Commission believes that these measures are sufficient in this regard, and that no further safety recommendations are warranted.

3. CONCLUSIONS

3.1. Findings

- The crew of the aircraft had valid licenses and medical certificates.
- The aircraft's documentation was valid and it was airworthy.
- The weather conditions did not influence the event and were not limiting to this type of flight.
- The crew declared an emergency to the Moroccan air traffic control service of CASABLANCA.
- The CASABLANCA control service did not authorize the emergency descent and instructed the crew to contact the Spanish air traffic control service.
- On 3 March 2018, before the incident considered herein, two incidents were reported to maintenance.
- After the two cabin pressure controllers were replaced, events continued to occur involving the loss of cabin pressure.

3.2. Causes/Contributing factors

The investigation was unable to realiably determine the cause of this incident.

1. According to the studies conducted during the investigation into this incident, it may have been caused by two possible faults.

   Initially, the #2 cabin pressure controller (CPC2) commanded the outflow valve (OFV) to open completely. The upset that opened the OFV was caused by corrupted data in the CPC. The source of that corrupted data was either a SEU or the result of failing solder joints.

   Later, due to the stiffness of the OFV, the #1 cabin pressure controller (CPC1) was unable to return it to its closed position and thus stabilize the cabin pressure. This may have been a factor contributing to the severity of the depressurization. It was possible to identify what caused the stiffness of the OFV.

2. After the incident, suspecting that both cabin pressure controllers had failed simultaneously, they were replaced; however, various anomalies continued to occur involving the loss of cabin pressure.

3. The aircraft operator did not provide information on what caused the loss of cabin pressure after the cabin pressure controllers were replaced. Moreover, it is not known if these subsequent incidents were analyzed in detail by the operator.

On 3 March 2018, before the incident, two other incidents involving cabin pressure were reported. It is thought that the lack of a detailed analysis of these prior incidents by the operator's maintenance technicians could have been a contributing factor in this incident.

4. SAFETY RECOMMENDATIONS

Since the operator is no longer operating, a recommendation will not be issued to the maintenance technicians.